



ISD Software Configuration Management

Number: 580-PC-019-01

Effective Date: February 1, 2005

Expiration Date: February 1, 2009

Approved By: (signature)

Name: Joe Hennessy

Title: Chief, ISD

Responsible Office: 580/Information Systems Division (ISD)

Title: ISD Software Configuration Management

Asset Type: Process

PAL Number: 3.1

Purpose

The purpose of software Configuration Management (CM) is to establish and maintain the integrity of the products of a software project throughout the software life cycle. Software CM involves four key activities: 1) identification of work products and baselines that are subject to configuration control; 2) approval/rejection of proposed changes to controlled items; 3) status tracking and reporting of changes and configuration data; and 4) audits to ensure that controlled items meet their requirements and are correctly documented.

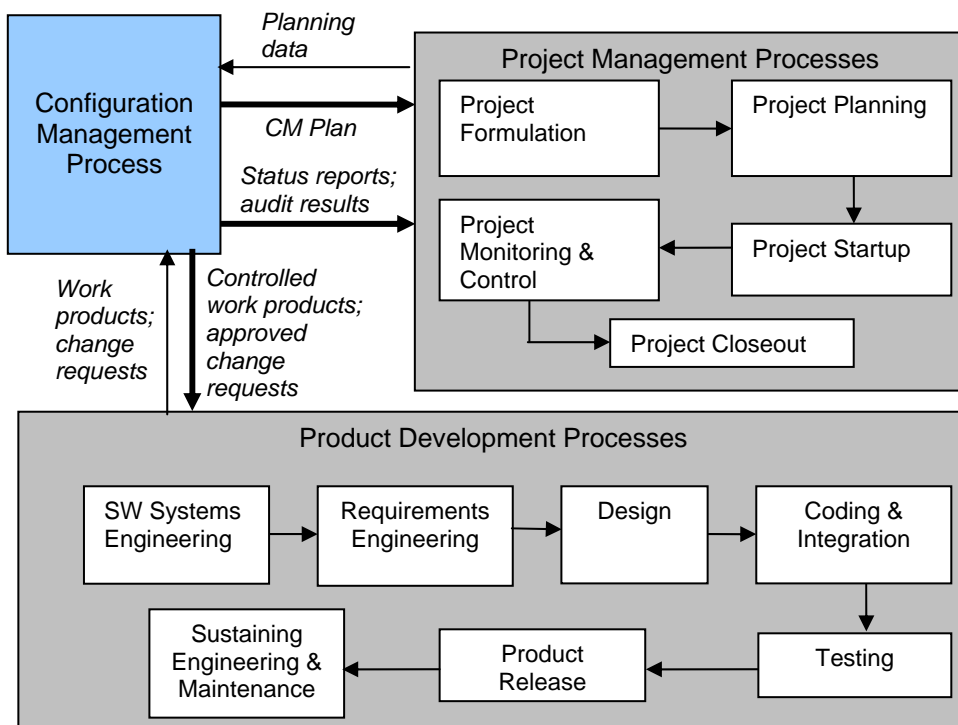
Scope

This process is to be followed on all ISD mission software projects. Software CM augments any CM conducted at the higher Mission Project level and must be coordinated with it.

“Work products” may include designated internal products in addition to products delivered to the customer. Software development tools, documentation, and acquired products are also considered to be work products.

Context Diagram

Configuration Management Context



Roles and Responsibilities	<p>Product Development Lead (PDL): (NOTE: The Software Manager or Systems Manager may also function as the PDL.)</p> <ul style="list-style-type: none"> • Is responsible for CM planning and for the overall control, evaluation, and approval of CM activities and tools for a software development project. • Appoints members to the software development Configuration Control Board (SW CCB) (a.k.a. Internal Review Board). • Appoints the SW CCB Chair, who has approval authority for all software documentation, baseline versions, and Discrepancy or Change Requests (DCRs). • Selects the Configuration Manager and Software Librarian. • Develops and maintains the project's CM Plan. <p>Configuration Manager (a.k.a. Configuration Management Officer):</p> <p><i>GUIDANCE: On small projects, the PDL may perform this role.</i></p> <ul style="list-style-type: none"> • Reports directly to the PDL. • Implements and maintains the CM system according to the project's CM Plan. • Coordinates, supports, and performs CM activities and reports on those activities to the PDL. • Ensures that items selected for implementation were approved by the SW CCB. • Uses the CM system to ensure the integrity of all items placed under configuration control. <p>Software Librarian:</p> <p><i>GUIDANCE: A member of the Product Development Team with good organizational skills and experience in file generation and maintenance should fill this role. On small projects, the Configuration Manager may perform this function.</i></p> <ul style="list-style-type: none"> • Organizes the software files and documentation received from software developers and builds a centralized software library. • Sets up a program support library for retention and controlled retrieval of software support documentation and change control records. • Assists the Configuration Manager in performing configuration control and configuration status accounting. <p>Software Development Configuration Control Board (SW CCB)</p> <p><i>GUIDANCE: The SW CCB is separate from the Mission Project CCB. It is also separate from the Divisional-level CCB that approves process assets.</i></p> <ul style="list-style-type: none"> • Approves all formal baselines and modifications that affect configured software elements. • Members are appointed by the PDL, who also appoints or functions as the SW CCB Chair. <p>GSFC Division Chiefs, Branch Heads, and Project Managers:</p> <ul style="list-style-type: none"> • May approve the Configuration Management Plan, and may review configuration management activities and reports. <p>Product Maintenance Lead (PML)</p> <ul style="list-style-type: none"> • Is responsible for CM planning and for the overall control, evaluation, and approval of CM activities for a maintenance project.
-----------------------------------	---

Roles and Responsibilities (Continued)	Product Development Team/Product Maintenance Team <ul style="list-style-type: none"> • Uses the CM library to obtain configured items. • Builds products from the library. • Supports the configuration management activities of the PDL/PML, Configuration Manager, and the SW CCB. • Follows the project's established CM procedures and guidelines. Software Assurance Representative <ul style="list-style-type: none"> • Reviews the application of CM procedures to determine if the CM Plan is being followed. • Verifies that CM audits are performed.
Usage Scenarios	<hr/> Initial Usage Scenario: The PDL uses this process during initial Project Planning to prepare the CM Plan, and during Project Startup to obtain the resources needed to execute the Plan successfully. Continuous Usage Scenario: The PDL, Product Development Team, Configuration Manager, Software Librarian, and SW CCB use this process (during execution of Product Development processes) to perform configuration management of the work products identified in the CM Plan. This usage supports Project Monitoring and Control . Final Usage Scenario: The PDL, Configuration Manager, and Software Librarian follow this process when a project is retired to ensure configuration management of work products being archived. (See Project Closeout .) <hr/>
Inputs	<hr/> <ul style="list-style-type: none"> • Project planning information (e.g., a draft of the Software Management Plan (SMP)/Product Plan • Candidate work products to be controlled (See Guidance in Task 2 for examples.) • Criteria for selection of work products to be controlled • Change requests and defect reports (e.g., Software Discrepancy or Change Requests (DCRs) and/or Nonconformance Reports (NCRs)) <div style="background-color: #f0f0f0; padding: 10px;"> <p><i>GUIDANCE: A template for the Configuration Management Plan for flight software projects can be found in the GSFC Process Asset Library under Organizational Support/Configuration Management.</i></p> <p><i>GUIDANCE: Examples of criteria for the selection of work products to be controlled include:</i></p> <ul style="list-style-type: none"> • <i>Will two or more groups use this work product?</i> • <i>Will the work product change over time?</i> • <i>Will changes to the work product affect other products?</i> • <i>Is the work product critical to the project?</i> </div> <hr/>
Entry Criteria	<hr/> <ul style="list-style-type: none"> • Project planning must be started. <hr/>
Exit Criteria	<hr/> <ul style="list-style-type: none"> • The Project Closeout process has been initiated. <hr/>

Outputs	<ul style="list-style-type: none"> • Configuration Management Plan • Configuration management system with controlled work products and access procedures • Change request database • Configuration audit results and action items • Configuration status reports • Archived baselines
Major Tasks	<p>This process consists of ten major tasks. Tasks 1 through 6 are performed sequentially during project planning and startup. Tasks 7 through 10 are executed iteratively during product development.</p> <ol style="list-style-type: none"> 1. Define levels of control, responsibilities, and methods for change authorization. (PDL/PML) 2. Identify configuration items. (PDL/PML) 3. Define CM procedures. (PDL/PML, Configuration Manager) 4. Prepare the CM Plan (PDL/PML) 5. Establish the software project's Configuration Control Board (SW CCB). (PDL/PML) 6. Setup CM tools and libraries. (Configuration Manager, Software Librarian) 7. Establish baselines. (Configuration Manager, SW CCB) 8. Perform configuration control. (Configuration Manager, Software Librarian, SW CCB) 9. Perform configuration status accounting. (Configuration Manager, Software Librarian) 10. Perform configuration audits. (Configuration Manager, Software Assurance Representative)
Task 1	<p>Define levels of control, responsibilities, and methods for change authorization. (PDL/PML)</p> <ol style="list-style-type: none"> a) Define the levels of control that will be used within the CM system. b) Specify how the project will record reviews and approvals by authorized personnel. c) Identify the persons or groups with authority to approve baselines, authorize changes, and to make changes at each level. d) Define the procedures to be followed for baseline authorization; to request, authorize, and process changes; to track and distribute changes, and to maintain past versions. <p><i>GUIDANCE: Different levels of control are often needed at different phases of the life cycle. For example, version control is usually needed for requirements development as well as for design, code, and unit testing by individual developers. More stringent, project-level controls are needed for builds, which contain integrated components and documentation. Lastly, full CM mechanisms will be needed to control product baselines that have been released for use.</i></p> <p><i>A project that is part of a higher-level (e.g., Mission) Project must conform to the Project's CM requirements as well as its own software CM procedures. Project-level CM may impose additional controls.</i></p>

Task 1
(Continued)

GUIDANCE: Examples of software change and SW CCB procedures can be found in the [FSW Configuration Management Plan Template](#).

Task 2

Identify configuration items. (PDL/PML)

- a) Identify the items to be placed under configuration control, when they will be controlled, and which items will be controlled at the higher Project (i.e., Mission) level.

GUIDANCE: Items that may be subject to configuration control include:

- Plans (e.g., the SMP/PP and subsidiary plans) and estimates
- Process and procedure descriptions (see [ISD Process Asset CCB Process](#))
- Requirements specifications
- Interface definition documents (ICDs and IRDs)
- Designs (data, specifications, and diagrams)
- Source code, object code, intermediate files, scripts
- Data and knowledge base instances
- Test cases, test scripts, and test results
- Acquired software, including COTS, GOTS, freeware
- Product documentation (e.g., system descriptions, user guides)
- Tools (e.g., compilers, debuggers)
- Review presentations and minutes, including RIDS/RFAs
- SW CCB minutes
- Audit evidence and results

- b) Identify product baselines for major stages in the project's life cycle (e.g., requirements baseline, design baseline, build/release baselines, acceptance baseline, operations baseline).
- c) Identify the products comprising each baseline down to the level of the smallest controllable unit.
- d) Define the naming and labeling conventions that will uniquely identify each configured item so that erroneous products or versions are not used.

GUIDANCE: Because testing, delivery, and/or maintenance of reused components, including COTS/GOTS, may differ from that of newly developed software, it is recommended that reused software components be clearly identified and that the identification scheme distinguish software components that have been modified from those that are being reused without modification.

Task 3

Define CM procedures. (PDL/PML, with support from the Configuration Manager)

- a) Create procedures (or identify existing procedures) that specify how to establish, control, update, release, deliver, and maintain configured items.
- b) Create or identify procedures for the backup, archival, and restoration of configured files.
- c) Create or identify the project's build procedures.
- d) Create or identify procedures for software reuse.

Task 3
(Continued)

- e) Create or identify the security procedures and access controls that will protect files under CM control from unauthorized modification or use.
- f) Create or identify procedures for the transfer or sharing of configured items among control levels.
- g) Create or identify procedures for generating CM status reports.

GUIDANCE: See the [FSW Configuration Management Plan Template](#) for procedure examples. Consider tracking acquired software separately to ensure the integrity of the software system.

Task 4

Prepare the CM Plan. (PDL/PML)

Create an explicit, written Software Configuration Management Plan. Use an approved CM Plan template, if available.

GUIDANCE: For small projects, the CM Plan is usually included within the Software Management Plan (SMP)/Product Plan. For large projects, the CM plan is often published separately, but it is still considered a subsidiary plan of the SMP/Product Plan.

- a) Specify the project organization(s) within which software CM is to apply.
- b) Identify the responsibilities and authority of the software CM organization.
- c) Identify the software CM policies and directives that apply to the project.
- d) Describe the methods, functions, and tasks required to manage the configuration of the software, including configuration identification, configuration control, status accounting, and configuration audits and reviews.
- e) Specify how releases will be managed and delivered.
- f) Specify what items will be controlled, who has authority to make changes, how the status of changes will be handled, and what configuration checking (audit) processes will be used.
- g) Provide schedule information that establishes the sequence and coordination of the identified activities and of all events affecting the CM Plan's implementation.
- h) Provide resource information, identifying the software tools, techniques, and equipment necessary for the implementation of CM activities.
- i) Identify the activities and responsibilities necessary to ensure continued CM planning during the life cycle of the project.

GUIDANCE: Additional guidance and templates for the CM Plan may be found in the [GSFC Process Asset Library](#) under [Organizational Support/Configuration Management](#).

Task 5

Establish the software project's Configuration Control Board. (PDL/PML)

- a) Establish and staff a Configuration Control Board (SW CCB) to manage, assess, and control changes to configured items. Include the lead development engineer, the lead test engineer, the Configuration Manager, and the Software Librarian along with other vested parties, such as a Mission Project representative/systems engineer and a user representative.
- b) Appoint a SW CCB Chair and Secretary.

Task 5
(Continued)

- c) Establish SW CCB rules and logistics (e.g., meeting location and schedule).

GUIDANCE: The PDL usually acts as the SW CCB Chair.

Task 6

Setup CM tools and libraries. (Configuration Manager and Software Librarian)

- a) Identify and install a COTS/GOTS configuration management tool to manage the project's configured work products. Select a tool that allows check in/out of current and past versions of a source file and generation of status reports.
- b) Identify and install a COTS/GOTS tool to track discrepancy reports.

GUIDANCE: Software CM and discrepancy reporting tools used at GSFC are listed in the [Tools](#) section of this document. It is recommended that a requirements management tool (e.g., DOORS) be used to maintain configuration control of the software requirements baseline.

Task 7

Establish baselines. (Configuration Manager, SW CCB)

- a) Create a baseline using configured items from the project's CM libraries.
- b) Document the set of configuration items contained in the baseline.
- c) Obtain authorization for release of the baseline from the SW CCB.
- d) Release the baseline and notify stakeholders.
- e) Make current baselines readily available.

GUIDANCE: Baselines provide a stable basis for the continuing evolution of the project's configured work products. A baseline collects related configuration items together into a single, uniquely identified entity that represents a well-defined point in the project's life cycle and is formally reviewed and agreed upon. Baselines provide a fallback position; changes to baselined work products must be made using formal change control procedures. (See [Task 8](#).)

Task 8

Perform configuration control. (Configuration Manager, Software Librarian, SW CCB)

- a) Accept change requests (e.g., DCR or NCR) from members of the software development team, testers, users or customers who feel they have encountered a problem with the software or would like to see implementation of an enhancement to the software. (*Configuration Manager*)
- b) Record change requests in the DCR database. (*Configuration Manager or Software Librarian*)
- c) Review all proposed changes to determine their potential impact to the project's approved software and documentation baselines. (*Configuration Manager, with support from the Product Development/Maintenance Team*)
- d) Recommend that each change request be approved, rejected, or deferred for further study. (*Configuration Manager, with support from the Product Development/Maintenance Team*)
- e) Approve, reject, or defer the change request. (*SW CCB*)
- f) Track the status of change requests and authorize their closure. (*Configuration Manager*)

Task 8 (Continued)	<p><i>GUIDANCE: If the software project's requirements are under control of a Mission Project and the SW CCB determines that proposed changes will adversely affect software performance, maintainability, reliability, cost, schedule, and/or scope, the SW CCB should forward the DCR to the Project Office CCB for handling. If proposed changes will result in an impact to spacecraft resources and/or interfaces to other subsystems, the SW CCB should consult with the Project Systems Engineering Office.</i></p>
Task 9	<p>Perform configuration status accounting. (<i>Configuration Manager, with support from the Software Librarian</i>)</p> <p><i>GUIDANCE: The Configuration Manager preserves the integrity of all system baselines, components, and products that are not under higher-level Project control.</i></p> <ul style="list-style-type: none"> a) Maintain records of the status and contents of the software throughout the project's life cycle. b) Record and monitor all changes to controlled software and documents to assure that the configuration of all identified items is known at all times. c) Document the contents of versions, builds, and releases. d) Make CM records readily available to affected groups and individuals. e) Produce periodic status reports. Include such information as the number of changes made to date, the reason for each change, the number of system releases to date, the functionality provided with each release, and the latest version and revision identifiers.
Task 10	<p>Perform configuration audits. (<i>Configuration Manager and Software Assurance Representative</i>)</p> <p><i>GUIDANCE: Configuration audits are performed to verify that CM libraries and baselines contain the correct versions of configuration items and that the configuration items conform to the documents that define them. Audits should be performed on a representative sample of configuration items.</i></p> <ul style="list-style-type: none"> a) Perform ad hoc audits of baselines. Confirm that CM records correctly identify the configuration items in the baseline. Check DCRs to ensure that changes have been incorporated correctly and completely and that the integrity of the baseline has been maintained. (<i>Configuration Manager</i>) b) After testing is complete, perform a functional configuration audit. Examine the Requirements-to-Test Matrices (RTMs) for selected configuration items to verify that the items function as specified in the requirements. (<i>Configuration Manager</i>) c) Prior to each release or baseline delivery, perform a physical configuration audit to verify that every delivery item (e.g., program input file, test software, or document) is as reported in the delivery documentation and release letter. Check each item on the delivery list or in the Version Description Document/Memo to ensure that the item is present, is complete, is the correct version, is in the specified delivery format, and is correctly identified. (<i>Configuration Manager</i>) d) Verify that configuration audits are performed and configuration management procedures are followed. (<i>Software Assurance Representative</i>).

Measures Measurements should be taken to determine the status of CM work, the cost of CM, and to compare trends in current vs. past projects. The following measures are recommended:

- Planned vs. actual CM effort
- Scheduled vs. actual milestone dates
- Number of CM audits performed
- Number of change requests received vs. number approved/rejected
- Number of approved change requests received vs. number completed
- Number of discrepancies (defects) by severity level and insertion point (i.e., requirements, design, implementation, test, maintenance)

Tools The Configuration Management tools listed below are recommended.

Name	Description
<i>FSW Configuration Management Plan Template</i>	A standard, reusable CM Plan for Flight Software (Code 582) projects that enables the user to “fill in the blanks.”
<i>GSFC Centralized Configuration Management System</i>	A database that allows documents to be stored online in a similar fashion to GDMS.
COTS CM Tools	Some COTS CM Tools in use at GSFC are: Continuous, Revision Control System (RCS), and Concurrent Version.
Discrepancy Reporting Tools	Tools in use at GSFC include COTS tools (Rational ClearQuest, NetResults, Bugzilla) and in-house systems such as the ESDIS DR Tracking Tool and the FSW Development DR System.

Course Name	Description
<i>Software Configuration Management</i>	A two-day course produced by TeraQuest and offered to NET Program Participants.

References This process is consistent with the following policies and standards.

- **NPR 7150.2**, NASA Software Engineering Requirements
- **GPG 1410.2B**, Configuration Management
- **GPG 8700.5**, In-House Development and Maintenance of Software Projects
- **580-PG-8730.3.1**, [*Product Development Handbook*](#)

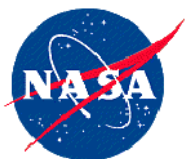
References
(Continued)

- **580-PL-002-01**, [ISD Software Policies](#)
Additional guidance for this process was obtained from
- **Glossary**: <http://software.gsfc.nasa.gov/glossary.cfm>
Defines common terms used in ISD processes
- **ETVX Diagram**: Link to the ETVX diagram for this process.
- **Process Asset Library**: <http://software.gsfc.nasa.gov/process.cfm>
Library of all ISD process descriptions
- **NASA Software Configuration Management Guidebook** at <http://satc.gsfc.nasa.gov/GuideBooks>
NASA-STD-8739.3 (draft), Standard for Software Assurance

**Quality
Management
System Records**

Controlled Document / Description	Record Custodian
Software Configuration Management Plan (CM Plan) – Although it may be published separately, this plan is considered to be a subsidiary document within the SMP/PP. The SMP/PP is a controlled document; see ISD Project Monitoring and Control .	Product Development Lead
Discrepancy reports – (a.k.a. Software Problem Reports) Reports of defects found in configured work products. May be tracked separately or with change requests, as in DCR (Discrepancy or Change Requests) tracking.	Configuration Manager
Change requests – (a.k.a. Software Change Requests) Requests for changes to configured work products.	Configuration Manager
SW CCB minutes Minutes of the SW CCB meeting. Records the disposition of all change/baseline requests received.	SW CCB Secretary
CM audit records Results of ad hoc audits as well as functional and physical configuration audits.	Configuration Manager

Change History	Version	Date	Description of Improvements
	1.0	1/26/05	Initial version approved by CCB



ISD Configuration Management (CM) ETVX* Diagram

Number: 580-ED-019-01
Effective Date: December 1, 2004
Expiration Date: December 1, 2009

Approved By: (signature)
Name: Joe Hennessy
Title: Chief, ISD

Responsible Office: 580/Information Systems Division (ISD)	Asset Type: ETVX Diagram
Title: ISD CM Process ETVX Diagram	PAL Number: 3.1

CM Process ETVX* Diagram

Inputs	Entry Criteria	Major Tasks	Exit Criteria	Outputs
Project planning information (e.g., a draft of the SMP or Product Plan) CM Plan Template Candidate work products to be controlled Criteria for selection of work products to be controlled Change requests and defect reports	Project Planning must be started	<ol style="list-style-type: none"> Define levels of control, responsibilities, and methods for change authorization Identify configuration items Define CM procedures Prepare the CM plan Establish the software project Configuration Control Board Setup CM tools, and libraries Establish baselines Perform configuration control Perform configuration status accounting 	Project Closeout has been initiated	CM Plan Configuration Management System with controlled work products and access procedures Change request database Configuration audit results and action items Configuration status reports Archived baselines
		Verification and Validation 10. Perform configuration audits		

Change History

Description of changes to the approved ETVX Diagram(s).		
Version	Date	Description of Changes
1.0	Jan.26, 2005	Initial CCB-approved version

Check the Process Asset Library at <http://software.gsfc.nasa.gov/process.cfm> to obtain the latest version.

NOTE: Words or phrases shown in blue underlined contain links to additional information.

Guidance & tailoring information is shown in *italics with gray background*.